

REMARKS

As required, the non-elected claims, claims 83 and 92, have been canceled. Claims 75 and 84, the only two independent claims, have been amended to clarify that the coating consists of an inorganic material that contains no liquid phase. As this amendment clearly disposes of the cited prior art, as kindly acknowledged by the Examiner in the Interview Summary, it is believed proper to enter the amendment. Support for the phrase "which includes no liquid phase" is found on page 11 at lines 9-13. Support for inorganic materials is found, for example, on page 28, line 11, and this of course, was already in the claim. Support for the alteration in the temperature range at the lower limit is found, for example, in claim 38 as originally filed. Thus, in addition to the virtue of obviating the cited art, the proposed amendments are fully supported by the specification.

In addition, claims 78 and 87 have been amended to delete those embodiments which have undefined subscripts or that contain organic components. The former was the intention in the previous response and was somehow omitted. Applicant appreciates the withdrawal of most of the rejections under 35 U.S.C. § 112 and apologize for the omission to cancel the offending sections of claims 78 and 87.

These amendments, made after final, are believed not to present any new issues and to be directly responsive to the rejections raised. Applicant would be deeply appreciative if these amendments were to be entered.

Applicant also appreciates the thorough and clear manner in which the Examiner has set forth the grounds for rejection, as well as the helpful discussion at the interview.

The Invention

As noted previously, applicant has found that in order to provide the appropriate area-specific resistance (ASR) for protons in the case of an inorganic material that does not contain a liquid phase so that this material can serve as a fuel cell electrolyte, it is necessary to provide such material in such thin layers that the electrolyte is unstable. Applicant has therefore found that by using a metal foil as a support, the integrity of the layers which serve as electronically-insulating proton-conducting (EIPC) coatings at a desired temperature range can be maintained.

The Rejection of Claims 75, 82, 84 and 91 as Anticipated by Smotkin, U.S. 5,846,669

The Office, in the written rejection, asserts that Smotkin discloses a “metal hydride foil which serves as the support which is coated on both sides by respective electrolyte-containing matrices which represents the inorganic/composite non-liquid material.” Applicant appreciates the acknowledgement in the Interview Summary that the claims as amended do not read on Smotkin.

As recognized by the Examiner, the materials on either side of the metal foil in Smotkin contain liquid electrolytes. At best, there is a matrix which contains a liquid on either side. As noted in column 3 at line 14:

The invention is a composite* comprising a dense proton permeable phase such as palladium hydride, which separates an alkali-containing matrix, for example, concentrated potassium hydroxide in a Teflon®-bonded potassium hexatitanate matrix or circulating alkali electrolyte, from an acid-containing matrix, for example concentrated phosphoric acid in a Teflon®-bonded silicon carbon matrix. This electrolyte system enables separate compartmentalization of the air (oxygen) electrode with an alkaline electrolyte and the fuel electrode with an acid electrolyte, respectively, while still maintaining the integrity of the fuel cell system.

* This term is used in a different sense from that of the claims.

The proposed amendment clarifies that the coating *consists of* an inorganic material that contains no liquid phase. Thus, the claimed component is not anticipated by Smotkin. (Because the coating is restricted simply to inorganic materials that do not comprise a liquid phase, the inherent area-specific resistance is no longer an issue with regard to anticipation over Smotkin.)

With regard to any assertion of obviousness, applicant points out that the purpose of the palladium hydride foil in Smotkin is to prevent transfer of material. As noted, for example, in column 5 at line 20, “the dense phase proton permeable material 17 prevents CO₂ produced (from organic molecules used as fuel) at the anode from carbonating the alkalide on the cathode side of the dense proton-permeable material 17.” There is thus no suggestion to use a foil in the present context. There are no liquid phase components in the claimed article for which a barrier is needed.

The disclosure of Smotkin, taken as a whole, indicates that the electrolytes contain liquid acid or liquid base and that the purpose of the foil is to prevent interchange of elements of either, across the barrier. There is no suggestion of the problem that the invention component is to solve — namely, in order to provide the requisite ASR where an inorganic material with no liquid phase is used exclusively as an electrolyte, the layers must be unacceptably thin and the metal foil can be provided as a support. Because the problem itself—the need to provide a support because the layer of material is too thin to be stable without a support—was not recognized prior to the present invention, the solution (the metal foil) cannot have been obvious prior to the present invention.

This is supported by MPEP 2141.02, which quotes from *In re Sponnoble* as follows:

[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the “subject matter as a whole” which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103.

In re Sponnoble, 405 F2d 578, 585, 160 USPQ 237, 243 (CCPA 1969).

Thus, Smotkin neither anticipates nor suggests the invention of claims 75-77, 82, 84-86 and 91.

Applicant further notes that the Interview Summary, although not the official record, hints at a possible rejection on the basis of combining Smotkin with documents which disclose some of the inorganic materials lacking a liquid phase, presumably on the basis that one might be motivated to substitute these materials for the liquid phase-containing matrices of Smotkin. It is unclear to applicant, however, why one would be so motivated. No basis for such motivation has been provided.

In addition, such a combination with respect to the indicated claims would constitute a new ground for rejection not necessitated by the present amendment, and would necessitate withdrawal of the finality of the rejection.

The Rejection of Claims 75-77, 80-82, 84-86 and 89-91 over WO 98/21777 ('777)

Rejection of the claims over this document (or its U.S. English language equivalent, patent No. 6,242,122) is based on similar grounds as those related to Smotkin. Again, it is believed that the document has been mischaracterized somewhat. While an impermeable metal foil layer is interposed between two portions of electrolyte, it is clear that the electrolyte is or contains a liquid and that the foil is designed to prevent flow of the components of the liquid across the cell. The abstract of '777 is quite explicit in this regard. Thus, as was the case in Smotkin, there is no anticipation because the electrolyte coated onto the barrier has a liquid phase and there is no obviousness because the problem that the invention solves is not suggested. There is no suggestion or recognition that very thin layers of inorganic electrolyte not containing liquid would be required.

As stated in regard to the rejection over Smotkin, the possible rejection hinted at in the Interview Summary based on '777 in combination with additional documents which disclose

specific materials is believed to fail as there is no motivation for combination of the disclosures of these documents. As noted previously, it is a requirement that a rationale for motivation to combine be provided for a rejection on the basis of a combination of documents to be sustained (*In re Rouffet*, 47 USPQ2d 1453 (Fed. Cir. 1998)).

And, as stated above, as this would constitute a new ground for rejection, the finality of the rejection would need to be withdrawn.

The Rejection of Claims 78-79 and 87-88 as Unpatentable Over Smotkin in Further View of Norby

This basis for rejection is believed in error for the same reasons set forth above with regard to Smotkin taken alone. While it is true that many of the materials set forth in claims 78-79 and 87-88 are described as appropriate electrolytes in Norby, there is no teaching in Norby that when used as electrolytes these components will be required to be so thin as to lack the needed integrity. Absent the work of the present inventors, there is no suggestion that this is a problem to be solved, much less there being a solution provided for this problem. And, as stated above, there is no motivation provided whereby the electrolyte of Smotkin should be replaced by the materials set forth in Norby.

Indeed, because Norby itself shows the “gap” in the temperature curve, *Norby in effect teaches that these materials are not appropriate electrolytes in the gap region.*

The Rejection of Claims 78-79 and 87-88 Over Smotkin in View of Crome, et al.,
the Kwang Publication or the Dorthe Publication

These rejections are all made on a basis similar to that set forth above with respect to Smotkin in combination with Norby. In each case, the secondary reference suggests that one of the materials articulated in the dependent claims can be used as an electrolyte. In no case, however,

does the secondary reference recognize or suggest that the resulting electrolyte must be supplied in a fragile, very thin layer, thus requiring the use of a solid support in the form of a metal or metal hydride.

In view of the foregoing, it is respectfully submitted that the rejections over the art may properly be withdrawn.

Enablement

There is no outstanding rejection based on an asserted lack of enablement. Respectfully, should such a rejection be made on the record, the finality of the rejection needs to be withdrawn. The claimed invention is fully enabled by the specification specifically, for example, the method of calculating the thickness of the layer required to obtain the appropriate area-specific resistance for any particular material is given on page 44, beginning at line 13, and the manner of coating the inorganic layer lacking any liquid phase is described on page 38, beginning at line 11 and continuing to page 40, line 3; preparation of the electrolytes themselves is described on page 34, beginning at line 10.

Applicant emphasizes, however, that this rejection is not of record, and should such a rejection be made, the finality of the rejection must be withdrawn in order to provide applicant with an appropriate opportunity to respond.

Comments on Response to Arguments

Applicant appreciates the detailed discussion of the arguments made in the previous response. In some cases, it appears unnecessary, however, for applicant to comment further; in others perhaps it is helpful to provide some comments at this point. Thus, while it is believed that the foregoing constitutes a complete response to the rejections as formulated by the Office, for

completeness, applicant responds briefly as follows to the pertinent numbers of paragraphs 15-34 which are characterized as responses to applicant's previous arguments. For convenience, the number of each paragraph at issue will be referred to in the following discussion.

As to paragraph 15, claims 75 and 84 have been amended to clarify that the electrolyte coatings are exclusively inorganic and have no liquid phase. Thus, Smotkin's concentrated phosphoric acid or concentrated potassium hydroxide are clearly distinguished. As to the Nafion[®] 115 polymer, as pointed out in the specification, the Nafion[®] polymer fails to meet the requirement that the ASR for protons is in the range of 0.1-100 Ohms/cm² at temperatures even as high as 175°C. This is noted, for example, on page 21 of the specification, lines 17-19. In addition, Nafion[®] contains water as a liquid phase. Indeed, this is why Nafion[®] does not work at high temperatures; when the water is boiled off, the membrane becomes inactive. With respect to the "freestanding polymer membrane" of '777, this evidently contains methanol which is itself a liquid.

With respect to paragraph 16, the issue is not whether an additional advantage of a combination was or was not recognized by applicant. The issue is whether the art recognized the problem to be solved by the present invention. There is no art cited which indicates that the art did indeed recognize the problem that the desired ASR for the non-liquid materials at high temperatures would require ultra-thin layers of these materials, and that such thin layers would require a support having very particular characteristics, *i.e.*, the ability to function as a proton conductor.

With respect to paragraph 17, applicant believes that Norby's statement can be taken at face value; however, applicant does not dispute that other documents can validly be cited.

It is believed that the comments in paragraphs 18-24 need not be commented on – the general propositions cited therein are not disputed and it is not believed that the comments therein are defeating of the specific responses set forth above.

With respect to paragraph 25, applicant's argument was simply that the art failed to teach a method to interface non-liquid coatings completely onto the metal hydride or metal in a manner sufficient to permit functionality as an electrolyte. While the Examiner is correct that a preamble may not necessarily limit the scope of the claim, in many cases it does. Where the nature of the preamble imposes specific features on a structure, it will serve as a limitation. This was the case, for example, in *Corning Glass Works v. Sumitomo Electric U.S.A., Inc.*, 868 F2d 1251, 9 USPQ2d 1962 (Fed. Cir. 1989) where a preamble which recited a "wave guide" was considered to read a structural limitation into the recited elements of the claim. A copy of this decision is enclosed for the convenience of the Office. Similarly, here, a component designed to serve as an electrolyte in a fuel cell would only be functional if the interface between the coating and the support were satisfactorily integrated. Therefore, in effect, the limitations the Office has requested to the claims already exist. *In any case, the subject matter of the claims has been distinguished from the cited documents without recourse to the preamble.* Similar comments apply to the points made in paragraphs 26-27.

The comments in paragraph 28 are not understood.

With respect to paragraph 29, again it is unclear why the thickness of the coating is not inherently limited by the ASR requirement. As noted, when the coating consists of an inorganic material that contains no liquid phase, each such material exhibits a satisfactory ASR only if it is very thin.

With respect to the argument with regard to non-analogous art, as set forth in paragraphs 30-31, it is believed this is moot in light of the arguments set forth above.

With regard to paragraphs 32-34, the previous arguments are believed unnecessary in light of the discussion set forth above.

Summary

For the reasons provided, the rejections over the art may properly be withdrawn and applicant respectfully requests the amendments be entered and claims 75-82 and 84-90 be passed to issue. Examiner Alejandro is again thanked for his consideration and thoughtful discussion at the interview.

Should minor issues remain that stand in the way of allowance that might be resolved by telephone, a telephone call to the undersigned is respectfully requested.

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, applicant petition for any required relief including extensions of time and authorize the Assistant Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing docket No. 491712000100.

Respectfully submitted,

Dated: June 21, 2005

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2. Claims 1-5 of the '368 Patent are not invalid despite the sales and public use of the RM-30 reeling machine more than one year prior to filing of the '368 Patent Application.

3. Claims 1-5 of the '368 Patent are not invalid despite documents disclosing details of the RM-30 reeling machine, including its control circuit, published more than one year before the filing date of the '368 Patent Application.

4. The invention set forth in Claims 1-5 of the '368 Patent was not in public use or on sale more than one year prior to the filing date of the '368 Patent Application.

5. The invention set forth in Claims 1-5 of the '368 Patent was not described in a printed publication more than one year prior to the filing date of the '368 Patent.

6. The invention set forth in Claims 1-5 of the '368 Patent would not have been obvious to one of ordinary skill in the art at the time the invention was made.

7. Plaintiff Southwest Aerospace Corporation (Southwest) will suffer immediate and irreparable harm if a preliminary injunction is not issued during the pendency of this action.

8. The balance of hardships and public interest tip decidedly in favor of issuance of a preliminary injunction under the facts of this case.

Preliminary Injunction shall issue as prayed for in Plaintiff's Application for Preliminary Injunction, except that it shall in no way restrain or enjoin or prevent Teledyne from completing the manufacture, sale and delivery of all items set forth in Yamada International Corporation Purchase Order No. N889/304P11297GAA dated January 28, 1988, and further provided that such injunction shall not issue until Plaintiff Southwest Aerospace Corporation has filed a corporate surety bond in format, form and surety approved by the Clerk in principal amount of \$100,000.00 conditioned as required by Rule 65(c), Fed.R.Civ.P.

Court of Appeals, Federal Circuit

Corning Glass Works v. Sumitomo Electric U.S.A. Inc.

Nos. 88-1192, 1193

Decided February 22, 1989

PATENTS

1. Patent construction — Claims — In general (§125.01)

Patent construction — Claims — Defining terms (§125.1305)

No litmus test exists to determine when

claim's introductory words, or preamble, constitute statement of purpose for device or are, in themselves, additional structural limitations, but rather effect of preamble language can be resolved only by reviewing patent in its entirety to gain understanding of what inventors actually invented and intended to encompass by claim.

2. Patent construction — Specification and drawings — In general (§125.1101)

Patent construction — Claims — Defining terms (§125.1305)

Specification which makes clear that inventors were working on particular problem of effective optical communication system, not on general improvements in conventional optical fibers, warrants finding that claim preamble words "an optical waveguide" do not merely state purpose or intended use for claimed structure but rather give "life and meaning" and provide further positive limitations to invention claimed.

3. Infringement — Doctrine of equivalents — In general (§120.0701)

Element, for purposes of "all elements" rule for finding infringement under doctrine of equivalents, is used in sense of limitation of claim; rule does not require equivalency in components, and thus, although equivalent must be found somewhere in accused device for every limitation of claim, it need not be found in corresponding component.

4. Infringement — Doctrine of equivalents — In general (§120.0701)

No definitive formula exists for determining equivalency between required limitation or combination of limitations and what has been allegedly substituted in accused device, but comparison of function/way/result of substitution with function/way/result of limitation in context of invention is helpful approach.

5. Infringement — Doctrine of equivalents — In general (§120.0701)

Substitution of ingredient known to be equivalent to that required by claim constitutes classic example of infringement under doctrine of equivalents.

6. Infringement — Doctrine of equivalents — In general (§120.0701)

Nothing is taken from public domain when issue of equivalency is directed to limitation only, in contrast to entirety of claimed invention.

7. Patentability/Validity — Anticipation — Prior art (§115.0703)

Assertion that Japanese patent application, which uses term "dopant" and which

lists polyvalent metal oxide dopants exclude germania and thus is prior art reference for claimed guide fiber that requires use of meritless, since, under such the genus would inherently disclose

Particular patents — General — Fiber optics

3,659,915, Maurer and Schu ca optical waveguide doped with amount of multivalent metal increase index of refraction of cladding, finding of validity of claims 1 and 2 affirmed.

3,884,550, Maurer and Schu mania and silica optical waveguide doped with germania not to have index of refraction of cladding, and having light at than 80 db/km, finding of validity of claim 1 affirmed.

3,933,454, DeLuca, meth optical waveguides by flame consolidated soot preform in sphere to produce water-free; non-infringement affirmed.

Appeal from the U.S. District Southern District of New York, USPQ2d 1545.

Corning Glass Works brought infringement action against Sumitomo Electric U.S.A. Inc., Sumitomo Electric Ltd., and Sumitomo Electric Triangle Inc., which brought declaration of invalidity action. The two actions were consolidated in federal district court. Corning Glass Works' patents in suit, defendants' patents in suit, defendants' counterclaims, and cross-appeals. Affirmed.

William K. West, Jr., of Cushman (George T. Mumtzis, Duane M. By Eccleston, of Cushman, man; Italo H. Ablondi, Sturgis M. Sobin, and P. Ablondi & Foster, with Washington, D.C., for Sumitomo Electric U.S.A. Inc., et al.

Lars I. Kulleseid, of Fish & Neave, N.Y. (W. Edwards M. Gantt, Thomas J. Ve Bloomberg, New York, N.Y. (K. McNeilsen and K. McNeilsen, with him on brief for Corning Glass Works.

Before Rich, Nies, and Judges. Nies, J.

ductory words, or preamble, element of purpose for device or lives, additional structural limitations, rather effect of preamble language resolved only by reviewing entirety to gain understanding of factors actually invented and encompassed by claim.

Construction — Specification and — In general (§125.1101)

Construction — Claims — Defining (25.1305)

which makes clear that in working on particular problem of optical communication system, improvements in conventional warrants finding that claim is "an optical waveguide" do not state purpose or intended use for but rather give "life and provide further positive limitation claimed."

Construction — Doctrine of equivalents (120.0701)

purposes of "all elements" in infringement under doctrine is used in sense of limitation does not require equivalency in and thus, although equivalent somewhere in accused device definition of claim, it need not be a bonding component.

Construction — Doctrine of equivalents (120.0701)

formula exists for determining between required limitation of limitations and what has been substituted in accused device, of function/way/result of each function/way/result of context of invention is helpful

Construction — Doctrine of equivalents (120.0701)

of ingredient known to be required by claim constitutes principle of infringement under equivalents.

Construction — Doctrine of equivalents (120.0701)

known from public domain equivalency is directed to limitation contrast to entirety of claimed

Validity — Anticipation — (15.0703)

Japanese patent application term "dopant" and which

lists polyvalent metal oxide dopants, does not exclude germania and thus is anticipatory prior art reference for claimed optical waveguide fiber that requires use of germania is meritless, since, under such theory, claim to genus would inherently disclose all species.

Particular patents — General and mechanical — Fiber optics

3,659,915, Maurer and Schultz, fused silica optical waveguide doped with sufficient amount of multivalent metal oxide to increase index of refraction of core above that of cladding, finding of validity and infringement of claims 1 and 2 affirmed.

3,884,550, Maurer and Schultz, fused germania and silica optical waveguide with core doped with germania not to exceed 15wt%, having index of refraction above that of cladding, and having light attenuation less than 80 db/km, finding of validity and infringement of claim 1 affirmed.

3,933,454, DeLuca, method of making optical waveguides by flame hydrolysis with consolidated soot preform in chlorine atmosphere to produce water-free glass, finding of non-infringement affirmed.

Appeal from the U.S. District Court for Southern District of New York, Conner, J.; 5 USPQ2d 1545.

Corning Glass Works brought patent infringement action against Sumitomo Electric U.S.A. Inc., Sumitomo Electric Industries Ltd., and Sumitomo Electric Research Triangle Inc., which brought action seeking declaration of invalidity and non-infringement. The two actions were consolidated. From federal district court decision in favor of Corning Glass Works on two of three patents in suit, defendants appeal and plaintiff cross-appeals. Affirmed.

William K. West, Jr., of Cushman, Darby & Cushman (George T. Mabile, Chris Comuntzis, Duane M. Byers, and Lynn E. Eccleston, of Cushman, Darby & Cushman; Italo H. Ablondi, F. David Foster, Sturgis M. Sobin, and Peter J. Koenig, of Ablondi & Foster, with him on brief), Washington, D.C., for Sumitomo Electric U.S.A., Inc., et al.

Lars I. Kulleseid, of Fish & Neave, New York, N.Y. (W. Edward Bailey, Daniel M. Gantt, Thomas J. Vetter, and Mark H. Bloomberg, New York; Alfred L. Michaelsen and K. McNeill Taylor, Jr., Corning, with him on brief), for Corning Glass Works.

Before Rich, Nies, and Bissell, circuit judges.
Nies, J.

Sumitomo Electric U.S.A., Inc. (SEUSA), Sumitomo Electric Industries, Ltd. (SEI), and Sumitomo Electric Research Triangle, Inc. (SERT), (collectively Sumitomo) appeal from the judgment of the United States District Court for the Southern District of New York, 671 F.Supp. 1369, 5 USPQ2d 1545 (S.D.N.Y. 1987) (Conner, J.), holding Sumitomo liable for infringement of claims 1 and 2 of United States Patent No. 3,659,915 ('915) and claim 1 of United States Patent No. 3,884,550 ('550), all directed to the structure of optical waveguide fibers. On appeal, Sumitomo challenges the validity of both patents and the finding of infringement of the '915 patent by one of its accused products. Corning Glass Works cross-appeals from the portion of the judgment holding that Sumitomo does not infringe another of its patents, United States Patent No. 3,933,454 ('454), which claims a method of making optical waveguide fibers. We affirm the judgment in all respects.

I

BACKGROUND

A. General Technology

The inventions involved in this case relate to optical waveguide fibers of the type now widely used for telecommunications, such as long-distance telephone transmissions. Such fibers were developed as a medium for guiding the coherent light of a laser a distance suitable for optical communications.

It had long been known that light could be guided through a transparent medium that was surrounded by another medium having a lower refractive index (RI). A glass fiber surrounded by air, for example, will function as a conduit for light waves, because air has a lower RI than glass. To prevent scratches, imperfections, or foreign materials on the fiber surface from scattering light away from the fiber, glass fibers were clad with a glass layer having a lower RI. Before 1970, however, these glass-clad, glass-core fibers, referred to generally as "fiber optics," were capable of transmitting light of practical

¹ In its opinion, 671 F.Supp. 1369, 5 USPQ2d 1545 (S.D.N.Y. 1987), the district court fully expounds the technological and historical background surrounding the inventions at issue. Provided here is that background necessary to understand the disposition of the issues. See also *Corning Glass Works v. United States Int'l Trade Comm'n*, 799 F.2d 1559, 230 USPQ 822 (Fed. Cir. 1986), a related case, for additional background information.

intensity only for very short distances due to high attenuation of the glass fibers then available. While suitable for illumination or for imaging systems, as in endoscopic probes, they could not be used for optical communications.

Another impediment to the use of conventional fiber optics for optical communications was the need that the fiber limit the transmitted light to preselected rays or "modes." In contrast, conventional fibers were designed to pass the maximum amount of incident light. The relatively large core diameter of conventional fibers permitted modes of light to enter the core over a fairly wide range of angles which, provided they entered at less than the critical angle, would be propagated along the fiber. Upon entering a fiber core, the light modes travel to the cladding and then back into the core, thus "bouncing" back and forth in a zig-zag path along the length of the fiber. The shallower the angle at which the modes enter the core, the less they will "bounce" and the sooner they will reach the receiving end of the fiber. When the number of modes are restricted, intelligibility of the information transmitted increases. The optimum restriction is achieved when only a single mode is transmitted, and by limiting the core diameter, that purpose is accomplished.

By the mid-1960's, worldwide efforts were ongoing to develop long-distance lightwave transmission capability. In particular, the British Post Office sought an optical waveguide with an attenuation of 20 db/km, the approximate transmission efficiency of the copper wire commonly used in the telephone communications.

B. The '915 Invention

Corning's work on optical waveguides began in 1966, when it was contacted by the British Post Office. Drs. Robert D. Maurer and Peter C. Schultz, working at Corning, developed the world's first 20 db/km optical waveguide fiber by early 1970. That achievement was due, in part, to the development of a fiber with a pure fused silica cladding and a fused silica core containing approximately three percent by weight of titania as the dopant in the core.² It was also due to the careful selection of the core diameter and the RI differential between the core and the cladding.

² Dopants are chemicals added to another material (here, fused silica) to alter one or more of its properties (here, the RI). The effect of the titania was to increase the RI of the core.

Bell Laboratories confirmed the attenuation measurements of Corning's fibers and considered Corning's achievement an important breakthrough, making long-distance optical telecommunications possible. Dr. Maurer first publicly reported the achievement of a 20 db/km optical waveguide fiber at the Conference on Trunk Telecommunications by Guided Waves held in London, England. That announcement created enormous interest and was the subject of many articles in both technical and general publications. The inventors' advancement in technology won them accolades from various societies and institutes, for which they were presented with many prestigious awards and honors. In addition, the invention of the '915 patent was achieved impressive commercial success on a worldwide basis. The district court determined that "[t]he '915 patent clearly covers a basic, pioneering invention." 671 F.Supp. at 1377, 5 USPQ2d at 1551.

The '915 patent discloses a fused silica optical waveguide fiber capable of limiting the transmitted light to preselected modes for use in optical communication systems. Specifically, such a fiber is disclosed as having a doped fused silica core and a fused silica cladding (doping optional), wherein the RI of the core is greater than that of the cladding. Prior to the filing date of the application for the '915 patent, the inventors had experimented with dopants which increased the RI of fused silica, e.g. titania, and the '915 specification mentions only such positive dopant materials. At the time the application was filed, the inventors did not know of specific dopants that would decrease the RI of fused silica, although it had been known in the art since 1954 that the introduction of fluorine decreases the RI of certain multicomponent glasses.

C. The '550 Invention

Corning's titania-doped fibers required heat treatment to reduce attenuation to an acceptable level. An undesirable result of that treatment was a lowering of the mechanical strength of the fibers. Consequently, Corning sought to develop a low attenuation fiber which did not require heat treatment. In 1972, Drs. Maurer and Schultz found a solution in doping a fused silica core with germania, which also had the advantage of transmitting more light than using titania.

D. The '454 Invention

Corning recognized that when optical waveguide fibers were produced by flame

hydrolysis, they contain residual hydroxy groups at certain wavelengths and, if the temperature increases, they increase the attenuation at certain wavelengths. Working with Dr. DeLuca, the inventors discovered that this inherent problem could be solved by the use of a chlorine-containing atmosphere in the furnace during the hydrolysis phase.

E. Disposition

Corning is the assignee of the '915 patent. SEI and SEUSA, are the assignees of the '550 and '454 patents. This appeal involves the validity of the '915 patent and the infringement of the '915 patent by SEI and SEUSA. The district court consolidated the '915 patent with the '550 and '454 patents and entered a declaration of invalidity of Corning's '915 patent. Corning filed a counterclaim for infringement of the '915 patent against SEI and SEUSA. The district court found in favor of Corning on its counterclaim and against SEI and SEUSA on their infringement of the '915 patent.

The trial court held that the '915 patent was valid and that SEI and SEUSA infringed the '915 patent. The '550 and '454 patents were also found to be valid and infringed by SEI and SEUSA. The subject of this appeal is the validity of the '915 patent.

Validity of Claims 1 and 2

On appeal Sumitomo Electric Industries, Inc. (SEI) and Sumitomo Electric U.S.A., Inc. (SEUSA) argue that they are entitled to a new United Kingdom patent (101). Anticipation of the claim is either expressly or impliedly, in a single prior art reference, *Kimberly-Clark v. Kimberly-Clark*, 218 USPQ 781, 782 (CA-11, 1984), 465 U.S. 100 (1984). While recent decisions in the field maintain that the claim is identical to the claim in the 101 reference.

³ SEI later joined SEUSA.

confirmed the attenuation of Corning's fibers and achievement an important long-distance operations possible. Dr. y reported the achievement optical waveguide fiber Trunk Telecommunications held in London, England created enormous subject of many articles and general publications. ncrement in technology from various societies which they were presented awards and honors. In n of the '915 patent was commercial success on a e district court deter- 5 patent clearly covers a ention." 671 F.Supp. at 1551.

discloses a fused silica er capable of limiting t to preselected modes munication systems. ber is disclosed as hav- silica core and a fused ng optional), wherein greater than that of the filing date of the appli- tent, the inventors had opants which increased i, e.g. titania, and the ntions only such posi- At the time the appli- nventors did not know at would decrease the although it had been e 1954 that the intro- creases the RI of cer- glasses.

50 Invention

oped fibers required uce attenuation to an undesirable result of lowering of the me- he fibers. Consequently develop a low attenu- id not require heat Drs. Maurer and ion in doping a fused ia, which also had the ating more light than

54 Invention

l that when optical e produced by flame

hydrolysis, they contained hydroxyl ions. The residual hydroxyl ions absorbed light at certain wavelengths used in optical communications and, if they remained, would increase the attenuation of the fiber at those wavelengths. Working at Corning, Dr. Robert D. DeLuca invented a process to overcome this inherent problem by introducing a chlorine-containing drying atmosphere into the furnace during the "consolidation" phase.

E. District Court

Corning is the assignee of the three patents at issue. SEI and its subsidiaries, SERT and SEUSA, are engaged in the manufacture and sale of optical waveguide fibers. This appeal involves two suits which were consolidated: an action by SERT³ seeking a declaration of invalidity and noninfringement of Corning's '915 and '454 patents with a counterclaim by Corning alleging SERT's infringement of those patents, and a suit by Corning against SEUSA and SEI asserting infringement of the '915, '550, and '454 patents.

The trial court held, *inter alia*, that claims 1 and 2 of the '915 patent and claim 1 of the '550 patent were not invalid and were infringed by Sumitomo. It found no infringement of the '454 patent. These rulings are the subject of this appeal and cross-appeal.

II Validity and Infringement of Claims 1 and 2 of 915 Patent A

On appeal Sumitomo attacks the validity of the '915 claims in issue solely on the ground that they are anticipated by the prior art United Kingdom Patent No. 1,113,101 (101). Anticipation requires that every limitation of the claim in issue be disclosed, either expressly or under principles of inherency, in a single prior art reference. *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 771, 218 USPQ 781, 789 (Fed. Cir. 1983), *cert. denied*, 465 U.S. 1026 [224 USPQ 520] (1984). While recognizing that the 915 patent discloses innovative work by the inventors in the field of fiber optics, Sumitomo maintains that the structure as claimed is identical to the fiber structure disclosed in the 101 reference.

³ SEI later joined SERT's action.

In this case, the question of anticipation turns on claim interpretation, a question of law. *Loctite Corp. v. Ultraseal Ltd.*, 781 F.2d 861, 866, 228 USPQ 90, 93 (Fed. Cir. 1985). If the claims are given Sumitomo's suggested interpretation, the 101 patent anticipates; otherwise, it does not. In particular, the dispute focuses on the interpretation and effect of the words "An optical waveguide" in claim 1⁴ which reads (paragraphing and identification provided):

An optical waveguide comprising

(a) a cladding layer formed of a material selected from the group consisting of pure fused silica and fused silica to which a dopant material on at least an elemental basis has been added, and

(b) a core formed of fused silica to which a dopant material on at least an elemental basis has been added to a degree in excess of that of the cladding layer so that the index of refraction thereof is of a value greater than the index of refraction of said cladding layer, said core being formed of at least 85 percent by weight of fused silica and an effective amount up to 15 percent by weight of said dopant material.

Sumitomo asserts that the above claim is anticipated by the disclosure in the 101 patent of a substantially transparent luminescent glass in the form of a fiber comprised of a doped silica core (up to 15% dopant) having a sheath of silica. While nothing in the '101 patent either expressly or impliedly discusses the use of the '101 fiber as an optical waveguide, Sumitomo points to testimony to the effect that the '101 fiber "inherently" could function as a "waveguide," albeit at most for a few meters. Per Sumitomo, Corning has merely specified a new use for an old structure by calling it "An optical waveguide." Thus, it urges that the words "An optical waveguide" in the claim should be ignored because the "preamble is not a limitation when it merely states a purpose or *intended use* and the remainder of the claim completely defines the invention."

Corning counters that the preamble words "An optical waveguide" constitute a limitation of the invention which must be interpreted as that term is defined in the '915 specification. "An optical waveguide" is there defined as follows:

[T]ransmitting media [for frequencies around 10¹⁴ hz] are hereinafter referred to as "optical waveguides." . . . [A]n optical waveguide should allow only preselected

⁴ Because we conclude that claim 1 is not anticipated, claim 2, which is dependent on claim 1, need not be separately discussed.

modes of light to propagate along the fiber.

United States Patent No. 3,659,915, col. 1, lines 34-39. In describing the physical attributes of an optical waveguide, the specification continues:

Optical waveguides are a unique type of optical fiber in that many of the physical characteristics and parameters must be carefully coordinated. . . . [A]s explained by N.S. Kapany if an optical fiber is to function as an optical waveguide, that is, limiting the transmitted light to preselected modes, the diameter of the core, the index of refraction of the core and the index of refraction of the cladding layer must be carefully coordinated.

Id. at col. 1, lines 49-51, 65-70. The specification then sets forth in detail the complex equation for the structural dimensions and refractive index differential necessary, in accordance with the invention, for in optical waveguide fiber comprising a fused silica core and cladding to transmit preselected modes of light. As so defined, per Corning, claim 1 of the '915 patent includes structural limitations not disclosed for the prior art '101 fibers. Without these limitations, Corning argues, an optical fiber does not function as the "optical waveguide" of the invention. Thus, per Corning, the claim does not merely specify a new use for the old product, and paragraphs labeled (a) and (b) of the claim do not completely define the structure of the invention.

[1,2] No litmus test can be given with respect to when the introductory words of a claim, the preamble, constitute a statement of purpose for a device or are, in themselves, additional structural limitations of a claim. To say that a preamble is a limitation if it gives "meaning to the claim" may merely state the problem rather than lead one to the answer. The effect preamble language should be given can be resolved only on review of the entirety of the patent to gain an understanding of what the inventors actually invented and intended to encompass by the claim. Here, the 915 specification makes clear that the inventors were working on the particular problem of an effective optical communication system not on general improvements in conventional optical fibers. To read the claim in light of the specification indiscriminately to cover all types of optical fibers would be divorced from reality. The invention is restricted to those fibers that work as waveguides as defined in the specification, which is not true with respect to fibers constructed with the limitations of paragraphs (a) and (b) only. Thus, we conclude that the claim preamble in this in-

stance does not merely state a purpose intended use for the claimed structure. *Kropa v. Robie*, 187 F.2d 150, 152, 48 USPQ 478, 481 (CCPA 1951). Rather, those words do give "life and meaning" and provide further positive limitations to the invention claimed. See *Loctite*, 781 F.2d 866, 228 USPQ at 92; *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 896, 221 USPQ 669, 675 (Fed. Cir.), cert. denied, 469 U.S. 857 [225 USPQ 792]. (1984). Thus, contrary to Sumitomo's argument, the core and cladding limitations specifically set out in paragraphs (a) and (b) are not the only limitations of the claim. See, e.g., *Diversitech Corp. v. Century Steps, Inc.*, 850 F.2d 675, 677-78, 7 USPQ2d 1315, 1317 (Fed. Cir. 1988) (affirming district court's use of claim preamble as a limitation). The claim requires, in addition, the particular structural relationship defined in the specification for the core and cladding to function as an optical waveguide.

Viewed in this manner, the fact that the '101 luminescent fiber could inherently transmit information for a few meters becomes irrelevant. The '101 patent does not disclose all the limitations of the claimed "optical waveguide" as that term is structurally defined by the '915 inventors.

While Sumitomo correctly states the general proposition that a court may not redraft a claim for purposes of avoiding a defense of anticipation, *McCarty v. Lehigh Valley R.R.*, 160 U.S. 110, 116 (1895); *E.I. du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1433, 7 USPQ2d 1129, 1131 (Fed. Cir. 1988), that proposition does not apply to this case. This is not a case where "extraneous" limitations from the specification are being read into the claim wholly apart from any need to interpret what the patentee meant by particular words or phrases in the claim. *Du Pont*, 849 F.2d at 1433, 7 USPQ2d at 1131. Here, the question is what effect to give to words in the claim. "It is entirely proper to use the specification to interpret what the patentee meant by a word or phrase in the claim." *Id.*

In sum, we are unpersuaded of legal or factual error in the district court's finding that the '915 claims are not anticipated by the prior art '101 patent.

B

The infringement issue on appeal involves only Sumitomo's S-3 fibers which were found to infringe under the doctrine of equivalents. A claim in a patent provides the metes and bounds of the right which the

patent confers on the patentee, and excludes others from making, using, or selling the patented invention. See *Mfg. Co. v. Linde Air Prods. Co.*, 333 U.S. 605, 607 [85 USPQ 328] explained in *Autogiro Corp. v. United States*, 384 F.2d 313 (Ct. Cl. 1967):

The claims of the patent are the concise formal definitions of the invention. They are the numbered, particularly [point] [claim] the subject matter of the patent. Applicant regards as the U.S.C. §112. It is to one must look to determine whether there has been infringement. 384 F.2d at 395-96. "These wordings" of a point out the invention in words or phrases (limitation of infringement claim must first be in 155 USPQ at 705, and, ed, they must be "read" structure to determine limitations recited in the accused structure. *Al George, Inc.*, 730 USPQ 473, 477 (Fed. Cir. 1988). To hold a patentee to his language in all cases could grant into a hollow and empty tank, 339 U.S. at 340. As explained in *Graver Tank*, 339 U.S. at 340:

"To temper unsparingly an infringer from making an invention" a patent is not a straitjacket. The doctrine [of equivalents] is a principle of equity which permits the producer of a substantially the same result. "Sanitary Tissue Co. v. American Tissue Co.", 280 U.S. 300, 304. The theory on which it is based is that "if two devices do substantially the same thing in substantially the same way, even though they are not the same in form, or shape." 97 U.S. 120, 121. *Graver Tank*, 339 U.S. at 340 [footnote on found that this is the correct met, stating:

Although fiber optic language of equivalent patent, it performs the same function in substantially the same way to obtain the same result as the guide fiber described in the '915 patent.

rely state a purpose or claimed structure. See 87 F.2d 150, 152, 88 CCPA 1951). Rather, "life and meaning" and "operative limitations" to the claim. See *Loctite*, 781 F.2d at 92; *Perkin-Elmer Corp. v. Westinghouse Electric Corp.*, 732 F.2d 888, 896, (Fed. Cir.), cert. denied, 5 USPQ 792 (1984). Sumitomo's argument, the limitations specifically set (a) and (b) are not the claim. See, e.g., *Divertry Steps, Inc.*, 850 F.2d 1315, 1317 (Fed. Cir. 1987) (affirming district court's use of "substantially the same" limitation). The claim, the particular structure recited in the specification according to function as an

inner, the fact that the fiber could inherently perform for a few meters before the 101 patent does not preclude the claimed structure as that term is structured by the '915 inventors.

Sumitomo correctly states the general rule that a court may not redraft a claim to avoid a defense of prior art. *Lehigh Valley Co. v. Phillips Petroleum Co.*, 116 F.2d 1116 (1895); *E.I. du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 430 F.2d 1433, 7 USPQ2d 1116 (1988), that proposition is not applicable to this case. This is not a "substantially the same" limitations from the prior art being read into the claim. *Du Pont*, 849 F.2d at 1131. Here, the district court's finding that the patentee meant in the claim." *Id.*

Sumitomo is not persuaded of legal or equitable grounds to reverse the district court's finding that the patentee's limitations are not anticipated by the prior art.

B

The issue on appeal involves whether the doctrine of equivalents applies to the '915 patent which provides the right which the

patent confers on the patentee to exclude others from making, using, or selling the protected invention. See *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 607 [85 USPQ 328, 330] (1950). As explained in *Autogiro Co. of America v. United States*, 384 F.2d 391, 155 USPQ 697 (Ct. Cl. 1967):

The claims of the patent provide the concise formal definition of the invention. They are the numbered paragraphs which "particularly [point] out and distinctly [claim] the subject matter which the applicant regards as his invention." 35 U.S.C. §112. It is to these wordings that one must look to determine whether there has been infringement.

384 F.2d at 395-96, 155 USPQ at 701. "These wordings" of a claim describe and point out the invention by a series of limiting words or phrases (limitations). In the determination of infringement, the words of the claim must first be interpreted, *id.* at 396, 155 USPQ at 705, and, as properly interpreted, they must be "read on" the accused structure to determine whether each of the limitations recited in the claim is present in the accused structure. *Envirotech Corp. v. Al George, Inc.*, 730 F.2d 753, 758, 221 USPQ 473, 477 (Fed. Cir. 1984). However, to hold a patentee to the precise claim language in all cases could turn "the patent grant into a hollow and useless thing." *Graver Tank*, 339 U.S. at 607 [85 USPQ at 330]. As explained in *Graver Tank*:

"To temper unsparing logic and prevent an infringer from stealing the benefit of an invention" a patentee may invoke this doctrine [of equivalents] to proceed against the producer of a device "if it performs substantially the same function in substantially the same way to obtain the same result." *Sanitary Refrigerator Co. v. Winters*, 280 U.S. 30, 42 [3 USPQ 40, 44]. The theory on which it is founded is that "if two devices do the same work in substantially the same way, and accomplish substantially the same result they are the same, even though they differ in name, form, or shape." *Machine Co. v. Murphy*, 97 U.S. 120, 125.

Graver Tank, 339 U.S. at 608 [85 USPQ at 330] (footnote omitted). The district court found that this test for infringement was met, stating:

Although fiber S-3 is not within the literal language of either claim 1 or 2 of the '915 patent, it performs substantially the same function in substantially the same way to obtain the same result as the optical waveguide fiber described in those claims of the '915 patent.

Corning Glass Works v. Sumitomo Elec. U.S.A., Inc., 671 F.Supp. 1369, 1387, 5 USPQ2d 1545, 1559 (S.D.N.Y. 1987).

In the instant case, there is no dispute that the accused S-3 fiber performs substantially the same overall function to obtain the same overall result as the claimed invention. The question then is whether it does so in "substantially the same way." As stated in *Perkin-Elmer Corp. v. Westinghouse Electric Corp.*:

Perkin-Elmer's repeated assertions that the claimed and accused devices perform substantially the same function and achieve substantially the same end result are not helpful. That circumstance is commonplace when the devices are sold in competition. That a claimed invention and an accused device may perform substantially the same function and may achieve the same result will not make the latter an infringement under the doctrine of equivalents where it performs the function and achieves the result in a substantially different way. *Graver Tank & Mfg. Co. v. Linde Air Products Co.*, 339 U.S. 605, 608, 70 S.Ct. 854, 856, 94 L.Ed. 1097, 85 USPQ 328, 330 (1950); see, e.g., *Sealed Air Corp. v. U.S. International Trade Comm'n*, 645 F.2d 976, 984, 209 USPQ 469, 476 (CCPA 1981).

822 F.2d 1528, 1531 n.6, 3 USPQ2d 1321, 1323-24 n.6 (Fed. Cir. 1987).

The accused S-3 fibers are optical waveguides as defined in the claims at issue in that the fibers have the differential in RI between core and cladding and the structural dimensions necessary for the preselection of particular modes of light waves. Thus, these limitations of claim 1 which, as above indicated, are required by the preamble are met in the accused S-3 fibers. Also, there is no dispute over a literal reading of paragraph (a) on these fibers. Corning concedes, however, that all of the limitations of paragraph (b) do not literally read on the accused fibers. Although each claim limitation may not literally be found in the accused structure, the "substantially the same way" prong of the *Graver Tank* test is met if an equivalent of a recited limitation has been substituted in the accused device, see *Graver Tank*, 339 U.S. at 610 [85 USPQ at 331]; see also *Pennwalt Corp. v. Durand-Wayland, Inc.*, 833 F.2d 931, 937, 4 USPQ2d 1737, 1741 (Fed. Cir. 1987) (in banc), cert. denied, 108 S.Ct. 1226, 1474 (1988); *Perkin-Elmer Corp.*, 822 F.2d at 1533, 3 USPQ2d at 1325; *Atlas Powder Co. v. E.I. du Pont de Nemours & Co.*, 750 F.2d 1569, 1579-80, 224 USPQ 409, 416 (Fed. Cir. 1984).

Applying these principles, the district court found that the accused S-3 fibers infringed the '915 claims. In so ruling, the district court recognized that the claim limitation calling for addition of a dopant to the core was not literally met in the accused S-3 fibers. 671 F.Supp. at 1387, 5 USPQ2d at 1559. Nevertheless, the court found that the substitution of "fluorine . . . dopant which negatively alters the index of refraction of fused silica [] in the cladding" equivalently met the limitation requiring the addition to the core of "a dopant which positively alters the index of refraction of fused silica." *Id.* at 1386-87, 5 USPQ2d 1559.

Sumitomo alleges clear error in the court's finding of equivalency. Per Sumitomo, nothing was substituted *in the core* of the S-3 fiber for a dopant which performed the function of increasing the core's refractive index, and, therefore, "an element" required by the claim, namely, a doped core, is entirely missing. Sumitomo asserts, that where an element of a claim is entirely missing, there is no infringement. The premise on which Sumitomo relies, known as the "All Elements" rule, see 4 D. Chisum, *Patents* § 18.03[4] (1986), correctly states the law of this circuit adopted in *banc* in *Pennwalt*. See *Pennwalt Corp.*, 833 F.2d at 935, 4 USPQ2d at 1739-40 (infringement requires that each element of a claim or its substantial equivalent be found in the accused device). However, we do not agree that an "element" of the claim is entirely "missing" from the S-3 fibers.

[3] Sumitomo's analysis illustrates the confusion sometimes encountered because of misunderstanding or misleading uses of the term "element" in discussing claims. "Element" may be used to mean a single limitation, but it has also been used to mean a series of limitations which, taken together, make up a component of the claimed invention.⁵ In the All Elements rule, "element" is used in the sense of a limitation of a claim. See *Julien v. Zeringue*, Nos. 87-1115, -1139, slip op. at 4 [9 USPQ 1552, 1553] (Fed. Cir. Jan. 5, 1989) ("If a claim limitation or its substantial equivalent is not present, there can be no infringement." (em-

⁵ See *Perkin-Elmer Corp. v. Westinghouse Electric Corp.*

References to "elements" can be misleading. . . . [C]larity is advanced when sufficient wording is employed to indicate when "elements" is intended to mean a component . . . of an embodiment of an invention and when it is intended to mean a feature set forth in or as a limitation in a claim.

822 F.2d at 1533 n.9, 3 USPQ2d at 1325 n.9.

phasis added)). Sumitomo's analysis is faulty in that it would require equivalency in components, that is, the substitution of something *in the core* for the absent dopant. However, the determination of equivalency is not subject to such a rigid formula.⁶ An equivalent must be found for every limitation of the claim somewhere in an accused device, but not necessarily in a corresponding component, although that is generally the case.

Corning urges that the question of equivalency here is a narrow one: Is the substitution of a negative dopant in the cladding equivalent to a positive dopant in the core? When the limitations of paragraph (b) are analyzed individually, the accused S-3 fibers literally meet the limitation that the fiber be composed of a core of fused silica as well as the limitation that "the index of refraction [of the core] is of a value greater than the index of refraction of said cladding layer." The question of equivalency then does center on the part of the claim following the word "core," namely, "to which a dopant material . . . has been added to a degree in excess of that of the cladding layer." If those limiting words are met equivalently, no "element," i.e., limitation, of the claim is missing.

In determining whether an accused device has an equivalent to a required limitation, the Supreme Court has advised:

What constitutes equivalency must be determined against the context of the patent, the prior art, and the particular circumstances of the case. Equivalence, in the patent law, is not the prisoner of a formula and is not an absolute to be considered in a vacuum. It does not require complete identity for every purpose and in every respect. In determining equivalents, things equal to the same thing may not be equal to each other and, by the same token, things for most purposes different may sometimes be equivalents. Consideration must be given to the purpose for which an ingredient is used in a patent, the qualities it has when combined with the other ingredients, and the function which it is intended to perform. An important factor is whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was.

Graver Tank, 339 U.S. at 609 [85 USPQ at 330-31].

[4] This court has not set out in its precedent a definitive formula for determining

⁶ A patentee is, for example, free to frame the issue of equivalency, if it chooses, as equivalency to a combination of limitations. *Winans v. Denmead*, 56 U.S. (15 How.) 330, 343 (1853).

equivalency between a required limitation and combination of limitations and been allegedly substituted there. Nor do we propose one here. We note that the district court resolved the question by comparing the function/way/result of the substituted limitation in the context of the invention; that made a subsidiary analysis of the overall function/way/result of the claim under the doctrine of infringement. In particular, after explaining how the accused S-3 fiber works, [t]he use of fluorine as a [negative] dopant in the cladding thus performs the same function in substantially the same way as the use of a [positive] dopant in the core to produce the same refractive index between the core and cladding which is necessary for the fiber to function as an optical waveguide.

671 F.Supp. at 1387, 5 USPQ2d at 1559. The district court's "functional" equivalency analysis with respect to the claim limitation appears to be in accord with the analysis in *Graver Tank*, 339 U.S. at 609 [85 USPQ at 331]. Support for this approach is found in our precedent. As one of our courts stated:

It is fundamental patent law that infringement is not avoided by substituting for an element in a claim another element which is its functional equivalent. . . . does substantially the same way as the original element, to produce the same result. Equivalency is a question of fact and must be determined by analyzing the elements or parts concerned. *Tektronix, Inc. v. United Technologies Corp.*, 323 F.2d 170, 171 USPQ 10, 11 USPQ2d 392, 395-96 (Ct. Cl. 1964), cert. denied, 379 U.S. 974 (1964). The court stated exactly as above in determining whether a limitation of the entire claim was infringed. In *Atla*, the court used the language to assess the substituted ingredient:

Where, as here, the accused device avoids literal infringement by substituting one ingredient of a claim for another, it is appropriate for a court to assess the substituted ingredient

Sumitomo's analysis is could require equivalency in is, the substitution of some- e for the absent dopant. termination of equivalency such a rigid formula.⁶ An e found for every limitation where in an accused device, y in a corresponding com- that is generally the case. hat the question of equiva- row one: Is the substitution ant in the cladding equiv- dopant in the core? When paragraph (b) are analyzed ccused S-3 fibers literally on that the fiber be com- fused silica as well as the ie index of refraction [of ue greater than the index id cladding layer." The lency then does center on aim following the word which a dopant material l to a degree in excess of ; layer." If those limiting ivalently, no "element," ne claim is missing. hether an accused device to a required limitation, has advised:

es equivalency must be st the context of the pat- , and the particular cir- e case. Equivalence, in s not the prisoner of a t an absolute to be con- um. It does not require for every purpose and in determining equivalents, : same thing may not be her and, by the same most purposes different : equivalents. Consider- en to the purpose for t is used in a patent, the en combined with the and the function which perform. An important r persons reasonably ould have known of the of an ingredient not tent with one that was S. at 609 [85 USPQ 2d]

ot set out in its prece- nula for determini-

imple, free to frame chooses, as equiva- tations. *Winn*, 330, 343 (1853)

equivalency between a required limitation or combination of limitations and what has been allegedly substituted therefor in the accused device. Nor do we propose to adopt one here. We note that the district court resolved the question by comparison of the function/way/result of the substitution with the function/way/result of the limitation in the context of the invention; that is, the court made a subsidiary analysis comparable to the overall function/way/result analysis mandated for determining infringement of the claim under the doctrine of equivalents. In particular, after explaining how the negative dopant of the S-3 fiber worked, it found: [t]he use of fluorine as a [negative] dopant in the cladding thus performs substantially the same function in substantially the same way as the use of a [positive] dopant in the core to produce the same result of creating the refractive index differential between the core and cladding of the fiber which is necessary for the fiber to function as an optical waveguide.

671 F.Supp. at 1387, 5 USPQ2d at 1559.

The district court's "function/way/result" equivalency analysis with respect to a claim limitation appears to be a helpful way to approach the problem and entirely in accord with the analysis actually made in *Graver Tank*, 339 U.S. at 609-10 [85 USPQ at 331]. Support for this approach is found in our precedent. As one of our predecessor courts stated:

It is fundamental patent law that infringement is not avoided by substitution for an element in a claimed device another element which is its full equivalent, i.e., does substantially the same thing in substantially the same way to get substantially the same result. Equivalency is a question of fact and must be resolved in each instance by analyzing the function of the elements or parts concerned.

Tektronix, Inc. v. United States, 445 F.2d 323, 329, 170 USPQ 100, referencing 165 USPQ 392, 395-96 (Ct. Cl. 1971). Although not stated exactly as above, this court has made that type of analysis repeatedly in determining whether a substitution was, in the context of the entire claim, an equivalent of a limitation. In *Atlas Powder*, for example, the court used the following similar language to assess the equivalency of the substituted ingredient:

Where, as here, the accused product avoids literal infringement by changing one ingredient of a claimed composition, it is appropriate for a court to consider in assessing equivalence whether the changed ingredient has the same purpose,

quality, and function as the claimed ingredient.

750 F.2d at 1579-80, 224 USPQ at 416. See also *Perkin-Elmer Corp. v. Westinghouse Elec. Corp.*, 822 F.2d at 1531-35, 3 USPQ2d at 1323-27 (substituted loop-coupling not equivalent because it did not produce the same structural-functional-operational interrelationships achieved by tap-coupling specified in claim); *Raytheon Co. v. Roper Corp.*, 724 F.2d 951, 962, 220 USPQ 592, 600 (Fed. Cir. 1983) (substituted hole in duct "performs substantially the same function in substantially the same way to obtain the same result" as . . . blower inlet" of the claim), cert. denied, 469 U.S. 835 [225 USPQ 232] (1984); *Caterpillar Tractor Co. v. Berco, S.p.A.*, 714 F.2d 1110, 1115, 219 USPQ 185, 187 (Fed. Cir. 1983) (thinner driving flange in accused seal did not affect the mode of operation or result obtained by flange in claimed invention).

[5,6] Finally, Sumitomo asserts that because the prior art, namely, United States Patent No. 3,320,114 (the Litton patent) teaches that a differential in the RI can be achieved between core and cladding in a fiber optic by negative doping of the cladding, Corning cannot assert equivalency between positive dopant in the core and negative dopant in the cladding. To do so, per Sumitomo, would "expan[d]" the claim to encompass what was already in the public domain, i.e., a fiber with a pure undoped core." Contrary to Sumitomo's argument, the substitution of an ingredient known to be an equivalent to that required by the claim presents a classic example for a finding of infringement under the doctrine of equivalents. *Graver Tank*, 339 U.S. at 609 [85 USPQ at 330-31] (important factor [in determining equivalency] is whether persons reasonably skilled in the art would have known of the interchangeability). Nothing is taken from the "public domain" when the issue of equivalency is directed to a limitation only, in contrast to the entirety of the claimed invention. This is such a case. The Litton patent teaches nothing about optical waveguides. Thus, the finding of equivalency in the substitution of a negative dopant in the cladding takes nothing from the "public domain."

With respect to our standard of review, we are mindful that:

A finding of equivalence is a determination of fact. Proof can be made in any form: through testimony of experts or others versed in the technology; by documents, including texts and treatises; and, of course, by the disclosures of the prior art. Like any other issue of fact, final

determination requires a balancing of credibility, persuasiveness and weight of evidence. It is to be decided by the trial court and that court's decision, under general principles of appellate review, should not be disturbed unless clearly erroneous. *Graver Tank*, 339 U.S. 609-10 [85 USPQ at 331]. A finding is clearly erroneous only if the reviewing court on the entirety of the evidence of record is left with a firm and definite conviction that a mistake has been made. *Anderson v. City of Bessemer City*, 470 U.S. 584, 573 (1985). The evidence in this case which consists of expert testimony concerning the operation of the negative dopant, the prior art, and the claimed invention amply support the district court's finding that an equivalent of the limitation in the claim was substituted in the accused device. We are unpersuaded the finding of equivalence is clearly erroneous.⁷

In sum we are unpersuaded of error either in the district court's understanding of the law; in its finding that adding negative dopant to the cladding is equivalent to adding positive dopant to the core in the context of the claimed invention; or in its finding that the S-3 fiber is an infringement of the inventions of claims 1 and 2 of the '915 patent.

III Validity of Claim 1 of the '550 Patent

Sumitomo asserts that claim 1⁸ of the '550 patent is invalid by reason of a statutory bar under 35 U.S.C. §102(b) (1982) based on a Japanese patent application of Corning which was published more than a year prior to the filing date of the corresponding United States application. Claim 1 of the '550 patent requires that germania be used in the core of the waveguide in excess of 15%. The district court found that the use of germania was not taught by the Japanese application. While conceding that the Japanese application does not expressly disclose germania as

⁷ The finding of equivalence does not depend on the status of the invention as a "pioneer," a finding disputed by Sumitomo on appeal.

⁸ Claim 1 of the '550 patent reads as follows:

An optical fiber comprising a cladding layer formed of high purity glass, and a core of high purity germania containing glass having an index of refraction above that of the cladding layer, said high purity germania containing glass having a cation impurity level not exceeding ten parts per million of transition elements and a germania content in excess of 15% by weight, said optical fiber having light attenuation of less than about 80 db/km at the utilization wavelength or wavelengths of light.

a dopant, Sumitomo seeks to rely on the principle that a reference may anticipate if the teaching is inherent in the cited prior art reference. *Verdegaal Bros. Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053-54 (Fed. Cir.), cert. denied, 108 S.Ct. 95 (1987) (anticipation may be shown if limitation is inherent in prior art reference).

[7] Sumitomo's argument regarding inherency is, specifically, that the use of the term "dopant" in the Japanese publication, together with a listing of polyvalent metal oxide dopants, "does not exclude germania." That argument approximates one for infringement, rather than inherency, and is confusing at best. Indeed, Sumitomo supports its novel section 102(b) argument by reference to the infringement analysis in *Specialty Composites v. Cabot Corp.*, 845 F.2d 981, 986, 6 USPQ2d 1601, 1604 (Fed. Cir. 1988). Under Sumitomo's theory, a claim to a genus would inherently disclose all species. We find Sumitomo's argument wholly meritless whether considered under section 102(b) or under 35 U.S.C. §103 (1982) to which it makes a passing reference. The Japanese application is a reference only for that which it teaches. As this court stated in *In re Benno*, 788 F.2d 1340, 226 USPQ 683 (Fed. Cir. 1985):

The scope of a patent's claims determines what infringes the patent; it is no measure of what it discloses. A patent discloses only that which it describes, whether specifically or in general terms, so as to convey intelligence to one capable of understanding.

768 F.2d at 1346, 226 USPQ at 686. Given the district court's full analysis of the merits of the anticipation defense, Sumitomo's convoluted argument that the district court must have thought the Japanese application was not prior art at all is wholly without substance.

Sumitomo also argues that claim 1 would have been obvious to one of ordinary skill in the art in view of United Kingdom Patent No. 1,108,509 ('509), which does disclose germania in the core. Sumitomo argues that the district court found that the '509 patent describes conventional fiber optics, e.g., those used in image intensifiers and television camera tubes, formed of multicomponent glasses containing between 35% and 62% germania together with numerous other materials. Sumitomo, however, ignores the court's finding that such conventional fiber optics contained light-absorbing impurities which made them wholly unsuitable for optical waveguide use. Neither of those findings have been shown to be clearly erroneous.

Sumitomo asserts the claim is limited to waveguide fiber; amendment of claim 1 which reads "optical fiber" to "waveguide" was made in other amendments that limit the percentage of light attenuation level of the core material; we conclude, as did the district court, that the amendments continued to waveguide fibers. Thus, the claim is distinguished from the '509 patent on this basis.

Sumitomo asserts error in the statement that the percentage of germania in the glasses of the '550 invention when used as a "dopant" is limited to a "minor" percentage and argues that the court's "striking example" of the "understanding" of the invention is in disagreement. Sumitomo makes no statement from the lengthy analysis. The district court is plainly aware of the high percentage of germania permitted by the claim; the court expressly referred to the entirety of the district court's findings; we are unpersuaded of a "lack of understanding" even referencing the claim 1 which we note is not. We agree that the '509 patent alone or in combination with the Japanese application does not disclose the invention insofar as it has not been proved that 102(b) or 103 is affirmed.

Corning's Cross of Claim 1

Corning contends that claim 1 of the '550 patent is clearly erroneous in not requiring a "cross" process.

Claim 1 of the '550 patent includes the following steps:

In the method comprising the steps of:
depositing on a substrate
a layer of flame
soot to form a

⁹ Because our review is limited to the patent process, we have no authority to question the particularity of the claim.

omo seeks to rely on the reference may anticipate if inherent in the cited prior art *Maal Bros. Inc. v. Union Oil* F.2d 628, 631, 2 USPQ2d (Fed. Cir.), *cert. denied*, 108 anticipation may be shown inherent in prior art

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Japanese publication, consisting of polyvalent metal does not exclude germania."

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i to be clearly erroneous.

Sumitomo asserts the claim in issue is not limited to waveguide fibers pointing to an amendment of claim 1 which changed waveguide" to "optical fiber." However, this amendment was made in conjunction with other amendments that limited the permissible percentage of light attenuation and purity level of the core material. Read together, we conclude, as did the district court, that the amendments continued to limit the claim to waveguide fibers. Thus the court correctly distinguished the claimed invention from the '509 patent on this basis.

Sumitomo asserts error in the court's statement that the percentage of germania in the glasses of the '550 invention was "minor" when used as a "dopant in fused silica." Sumitomo points out that the claim is not limited to a "minor" percentage of germania and argues that the court's statement is a "striking example" of the court's "lack of understanding" of the subject matter. We disagree. Sumitomo merely lifts an isolated statement from the text of the court's lengthy analysis. The district court was plainly aware of the high range of germania permitted by the claim itself inasmuch as the court expressly referred to it. Considering the entirety of the district court's discussion, we are unpersuaded that it exhibited any "lack of understanding" of the claim or was even referencing the claim *language* of claim 1 which we note is not limited to fused silica. We agree that the '550 invention would not have been obvious from the teachings of the '509 patent alone or in conjunction with the Japanese application. Accordingly, the judgment insofar as it held that the '550 patent had not been proved invalid under sections 102(b) or 103 is affirmed.

IV

Corning's Cross Appeal: Infringement of Claim 1 of the '454 Patent

Corning contends that the district court clearly erred in not finding infringement of claim 1 of the '454 patent by SERT's process.⁹

Claim 1 of the '454 patent recites the following steps:

In the method of forming a glass article comprising the steps of
depositing on a starting member a coating of flame hydrolysis-produced glass soot to form a soot preform,

⁹ Because our review of this issue involves certain proprietary information involving SERT's process, we have not discussed the process with particularity.

consolidating said soot preform to form a dense glass layer free from particle boundaries, and

forming said dense glass layer into a desired shape, said consolidation step being characterized in that it comprises

heating said soot preform to a temperature within the consolidation temperature range for a time sufficient to cause said soot particles to fuse and form a dense glass layer, and simultaneously

subjecting said soot preform to a stream of a substantially dry, hydrogen-free, chlorine containing atmosphere that is substantially free from contaminants that would adversely affect the optical properties of said glass article, *said chlorine permeating the interstices of said soot preform during the consolidation thereof and replacing hydroxyl ions by chlorine ions*, thereby resulting in a glass article that is substantially water-free.

Col. 13, lines 13-35 (emphasis added).

The district court found that SERT's process does not meet the limitations of a chlorine-containing atmosphere, during consolidation, wherein the chlorine permeates the interstices of the soot preform and replaces the hydroxyl ions with the chlorine ions either literally or by equivalent steps. Only the court's finding regarding nonequivalency is challenged on appeal.

The SERT process substitutes a particular compound (SERT compound) for the chlorine used for dehydration during the consolidation phase of the claimed process. Corning argues that the SERT compound performs the same function of dehydration in the SERT process as chlorine serves in the claimed process. In explaining why the use of the SERT compound was not the substantial equivalent for use of chlorine, the district court stated, "There is *no evidence* that [the SERT compound] functions in a comparable manner" (emphasis added). Latching onto the words "*no evidence*," Corning contends that the district court was grossly in error inasmuch as, per Corning, it presented "ample evidence . . . without credible contradiction," that the SERT compound is a well-known dehydration agent able to perform the same function as chlorine. Sumitomo, in response, points to evidence that was before the court which, *inter alia*, showed that the SERT compound did not permeate the interstices of the soot preform. In context, the district court's statement cannot be taken to mean that there was no effort by Corning to prove that the SERT compound functioned in a manner comparable to chlorine and that Corning's evidence was not considered or

